

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 15 FEB 2006

PCT
WIPO

| | | | |
|--|--|---|-----------------------|
| Applicant's or agent's file reference 49133-PT | | FOR FURTHER ACTION | See Form PCT/IPEA/416 |
| International application No. PCT/CA2004/001780 | International filing date (day/month/year) 01 October 2004 (01-10-2004) | Priority date (day/month/year) 03 October 2003 (03-10-2003) | |
| International Patent Classification (IPC) or national classification and IPC IPC: B22D 11/06(2006.01), B22D 9/00 (2006.01), B22D 7/06 (2006.01) | | | |
| Applicant ALCAN INTERNATIONAL LIMITED ET AL | | | |
| <p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of <u>4</u> sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> (sent to the applicant and to the International Bureau) a total of <u>1</u> sheets, as follows:</p> <p style="padding-left: 40px;"><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p style="padding-left: 40px;"><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. 1 and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p> | | | |
| <p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the report</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input checked="" type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p> | | | |
| Date of submission of the demand 20 May 2005 (20-05-2005) | | Date of completion of this report 1 February 2006 (01-02-2006) | |
| Name and mailing address of the IPEA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001(819)953-2476 | | Authorized officer Susan E. Woodhead (819) 997-2916 | |

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/CA2004/001780

Box No. I Basis of the report

1. With regard to the language, this report is based on:

- ☒ the international application in the language in which it was filed
- ☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of:
- ☐ international search (Rules 12.3(a) and 23.1(b))
- ☐ publication of the international application (Rule 12.4(a))
- ☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the elements of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

- ☐ the international application as originally filed/furnished
- ☒ the description:
- ☒ pages 1 to 7 and 9 to 14 as originally filed/furnished
- ☒ pages* 8 received by this Authority on 20 May 2005 (20-05-2005)
- ☐ pages* received by this Authority on
- ☒ the claims:
- ☐ pages as originally filed/furnished
- ☐ pages* as amended (together with any statement) under Article 19
- ☒ pages* 15 to 19 received by this Authority on 20 May 2005 (20-05-2005)
- ☐ pages* received by this Authority on
- ☒ the drawings:
- ☒ pages 1/3 and 2/3 as originally filed/furnished
- ☒ pages* 3/3 received by this Authority on 20 May 2005 (20-05-2005)
- ☐ pages* received by this Authority on
- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of those sheets may be marked "superseded."

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/CA2004/001780**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. Statement**

| | | | |
|-------------------------------|--------|----------------|-----|
| Novelty (N) | Claims | <u>1 to 33</u> | YES |
| | Claims | <u>none</u> | NO |
| Inventive step (IS) | Claims | <u>1 to 33</u> | YES |
| | Claims | <u>none</u> | NO |
| Industrial applicability (IA) | Claims | <u>1 to 33</u> | YES |
| | Claims | <u>none</u> | NO |

2. Citations and explanations (Rule 70.7)

D1 FR 1364717
D2 US 4934443
D3 US 4250950
D4 US 5515908
D5 US 6135199
D6 US 6063215
D7 US 4061177
D8 US 4061178
D9 US 5636681
D10 US 63132751

Novelty:

D1 is regarded as being the closest prior art in that it specifies a single or double belt casting apparatus having a flexible metal belt with belt cooling from the reverse side of the belt with the casting surface provided with a plurality of regular longitudinal grooves. Fig. 4 illustrates the preferred type of casting apparatus of applicant of the present alleged invention.

D2 and D4 are also considered to teach the essential features of applicant's alleged invention.

Specific characteristics are taught by D2 (belt material), D9 (parting removal apparatus), D10 (angled grooves other than in the longitudinal direction), D3, D5, D6 (regular and longitudinal grooves generally known in the same art), and D1, D7, D8 (applicant's basic preferred apparatus)

The amended claims 1 to 33 appear to meet the requirements of Article 33(2) PCT as none of the prior art references disclose surface roughness of the order of magnitude defined by the applicant.

Inventive Step:

The amended claims 1 to 33 appear to meet the requirements of Article 33(3)PCT as it would not be considered within the realm of normal experimentation to establish the defined range of surface roughness which differs so greatly from the levels previously considered to be effective.

Industrial Applicability:

The subject matter of claims 1 to 33 is of industrial use in the casting art. (Article 33(4) PCT)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/CA2004/001780

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

Article 5 Defects

Incorporation by reference

page 6, line 16
page 8, line 14
page 9, line 15
page 11, line 1

These references in the disclosure may be permitted under the laws of some contracting states to the PCT.

surfaces of the belts 12 and 14. The width of the cast strip 30 is defined by side dams (not shown) that are located near the edges of the casting belts 12, 14.

The belts themselves are constructed in an appropriate manner for a casting machine of this type, being advantageously of metal of appropriately high strength and of such a nature that they can be sufficiently tensioned without plastic yield. Although, for use in the present invention, the belts can be made of steel or any other material that is conventionally used for belts of this kind, high conductivity metals are preferred for the present invention, e.g. appropriate copper alloys. Even aluminum alloys having the required properties may be used as disclosed in co-pending PCT Publication No. WO 2005/032744 A1, published on April 14, 2005 in the names of Willard M. T. Gallerneault et al., and assigned to the same assignee as the present application, the disclosure of which is incorporated herein by reference.

In accordance with the present invention, one or preferably both casting belts are provided with a texture on the surface thereof in order to modulate the heat flux from the molten metal and to stabilize the points of contact between the molten metal and the casting belt (i.e. the metal meniscus), thereby avoiding casting defects in the resultant metal strip and also eliminating or reducing thermal distortion due to the thermal stress imposed on the belt. In the present invention, the casting surface of the belt is textured by creating multiple elongated grooves oriented in substantially the same direction, preferably the moving direction of the casting belts, i.e. in substantially the longitudinal direction of the belts. In other words, the major directional component of each groove preferably runs along the moving or longitudinal direction of the casting belt. The provision of such grooves can be achieved, for example, by grinding the belt surface with a grinding medium, e.g. a grinding paper or fabric, using a grinding machine, such as a belt sander or grinder, operating in the longitudinal direction of the belt. The grinding medium is chosen to produce the desired average surface roughness, i.e. within the range of 18 to 80 micro-inches (0.46 to 2.0

- 15 -

CLAIMS:

1. A continuous belt casting apparatus, comprising a casting cavity, at least one flexible metal belt having an elongated casting surface passing through and at least partially defining the casting cavity, a motor for rotating said at least one metal belt in a longitudinal direction of said casting surface whereby said casting surface passes through said casting cavity in said longitudinal direction, and a molten metal supply device adapted to deliver molten metal continuously to the casting cavity, whereby molten metal supplied to the casting cavity is solidified and removed as a continuous strip ingot from said casting cavity by rotation of said at least one belt, wherein said casting surface is provided with a plurality of grooves oriented in substantially the same direction, and wherein said plurality of grooves impart a surface roughness (R_a) to the casting surface, said surface roughness (R_a) being in the range of 18 to 80 micro-inches (0.46 to 2.0 micrometers).
2. The apparatus of claim 1, wherein the roughness (R_a) of the casting surface is in a range of 18 to 65 micro-inches (0.46 to 1.65 micrometers).
3. The apparatus of claim 1, wherein the roughness (R_a) of the casting surface is in a range of 25 to 45 micro-inches (0.64 to 1.14 micrometers).
4. The apparatus of claim 1, wherein said at least one casting belt is made of copper or a copper alloy.
5. The apparatus of claim 1, wherein said at least one casting belt is made of aluminum or an aluminum alloy.
6. The apparatus of claim 1, wherein the casting belt is made of steel.

- 16 -

7. The apparatus of claim 1, wherein the grooves are oriented in a direction within 45 degrees of the longitudinal direction of the casting surface.

8. The apparatus of claim 1, wherein the grooves are oriented
5 substantially in the longitudinal direction of the casting surface.

9. The apparatus of claim 1, being a twin belt caster provided with two belts.

10. The apparatus of claim 1, including a supply device adapted to supply an at least partially volatile liquid parting agent to said casting
10 surface before said casting surface contacts molten metal in the casting cavity.

11. The apparatus of claim 10, further including a removal device adapted to remove said parting agent from said casting surface after said casting surface exits said casting cavity and separates from said
15 continuous strip ingot.

12. The apparatus of claim 1, including means for applying coolant to a reverse side of said metal belt as it passes through the said casting cavity.

13. A method of casting metal to form a continuous strip ingot,
20 which comprises forming a casting cavity by providing at least one flexible metal belt having an elongated casting surface with the casting surface passing through and at least partially defining the casting cavity, continuously supplying molten metal to the casting cavity and rotating the belt in a longitudinal direction of the casting surface to draw said molten
25 metal through the casting cavity and to remove from the cavity a solidified strip ingot formed as said molten metal solidifies in the casting cavity, wherein said casting surface is provided with a plurality of grooves

- 17 -

oriented substantially in the same direction, and wherein said casting surface is provided with a plurality of grooves that impart a surface roughness (R_a) to the casting surface, said surface roughness (R_a) being in the range of 18 to 80 micro-inches (0.46 to 2.0 micrometers).

5 14. The method of claim 13, wherein the casting surface is provided with grooves that impart a surface roughness (R_a) to the casting surface in a range of 18 to 65 micro-inches (0.46 to 1.65 micrometers).

10 15. The method of claim 13, wherein the casting surface is provided with grooves that impart a surface roughness (R_a) to the casting surface in a range of 25 to 45 micro-inches (0.64 to 1.14 micrometers).

16. The method of claim 13, which comprises providing said at least one casting belt made of copper or a copper alloy.

17. The method of claim 13, which comprises providing said at least one casting belt made of aluminum or an aluminum alloy.

15 18. The method of claim 13, which comprises providing said at least one casting belt made of steel.

20 19. The method of claim 13, which comprises employing as said casting surface a surface on which said plurality of grooves is oriented in a direction within 45 degrees of the longitudinal direction of the casting surface.

20. The method of claim 13, which comprises employing as said casting surface a surface on which said plurality of grooves is oriented substantially in the longitudinal direction of the casting surface.

25 21. The method of claim 13, which comprises providing two belts to define said casting cavity.

- 18 -

22. The method of claim 13, which comprises supplying molten aluminum or aluminum alloy to said casting cavity as said molten metal.

23. The method of claim 13, which further comprises supplying an at least partially volatile liquid parting agent to said casting surface
5 before contacting said casting surface with said molten metal.

24. The method of claim 23, which further comprises removing said parting agent from said casting surface after said casting surface exits said casting cavity and separates from said continuous strip ingot.

25. The method of claim 13, which further comprises applying
10 coolant to a reverse side of said belt as it passes through said casting cavity.

26. A casting belt adapted for use in a continuous belt caster, said casting belt comprising a flexible metal belt having an elongated casting surface provided with a plurality of grooves oriented in
15 substantially the same direction, and wherein said plurality of grooves impart a surface roughness (R_a) to the casting surface, said surface roughness (R_a) being in the range of 18 to 80 micro-inches (0.46 to 2.0 micrometers).

27. The casting belt of claim 26, wherein the roughness (R_a) of
20 the casting surface is in a range of 18 to 65 micro-inches (0.46 to 1.65 micrometers).

28. The casting belt of claim 26, wherein the roughness (R_a) of the casting surface is in a range of 25 to 45 micro-inches (0.64 to 1.14 micrometers).

25 29. The casting belt of claim 26, wherein said belt is made of copper or a copper alloy.

- 19 -

30. The casting belt of claim 26, wherein said belt is made of aluminum or an aluminum alloy.

31. The casting belt of claim 26, wherein said belt is made of steel.

5 32. The casting belt of claim 26, wherein the grooves are oriented in a direction within 45 degrees of the longitudinal direction of the casting surface.

33. The casting belt of claim 26, wherein the grooves are oriented substantially in the longitudinal direction of the casting surface.

3/3

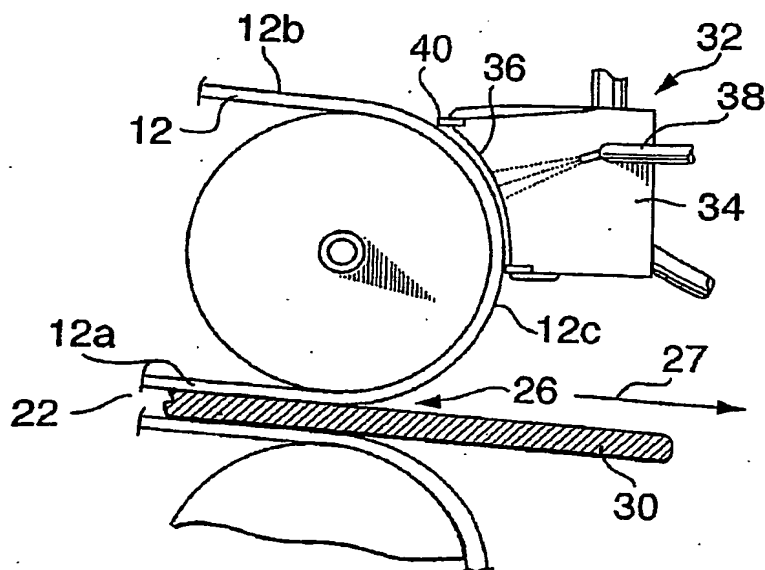


FIG. 5

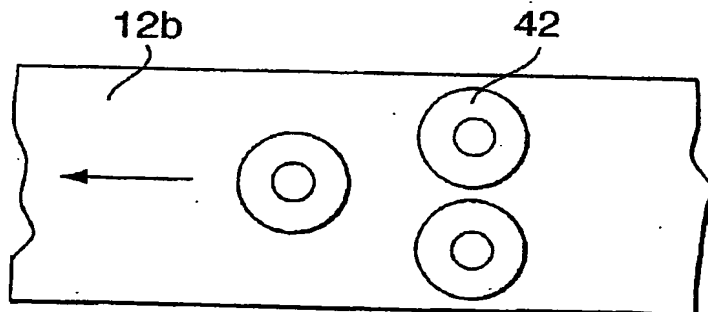


FIG. 6

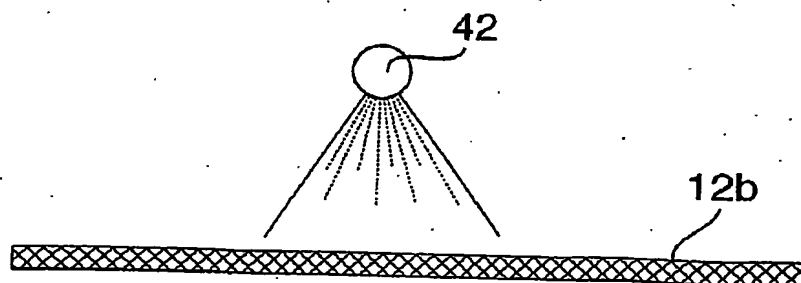


FIG. 7

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☒ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.